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Tests With Carbofuran[1/] to Control the Nantucket Pine Tip Moth[2/] on a Shortleaf Pine Seed Orchard

by

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ABSTRACT

Field tests were conducted at the Stuart Seed Orchard in Pollock, La., during 1974, 1975, and 1976 with carbofuran 10% G) for protection of shortleaf pine tips and in 1975 and 1976 for protection of conelets from damage by the Nantucket pine tip moth, Rhyacionia frustrana (Comstock). Granules were applied to trees that averaged 4.31 m tall at the rate of 11, 22, 44, and 88 g/cm (1, 2, 4, and 8 oz/in) d.b.h. once (February) and twice (February and June) in 1974. Rates of 22, 44, and 88 g gave season-long tip protection (< 11% damaged tips) in 1974. Two applications of a dosage rate did not differ significantly from a single application of the same rate. Except for the 224 g (applied twice) treatment, residual tip protection did not last through June 1975. In 1975, carbofuran (10% G) was applied to trees that averaged 8.5 m tall at the rates of 44, 88, 132 g/cm (4, 8, 12 oz/in) d.b.h. Only the rate of 132 g gave season-long protection to tips (< 11% damage). No protection from tip moth damage to conelets was found in 1975 test. In 1976, both October and February treatments showed significant protection to tips over checks in June 1976; however, no significant difference among treatments for tip protection occurred in September 1976. No significant difference among treatments for conelet protection occurred in 1975; however, significant differences (5% level) for tip moth damaged conelets occurred between the check and both the October and February treatments.

1/ Mention of a pesticide or proprietary product does not constitute recommendation or endorsement by the USDA.

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INTRODUCTION

The Nantucket pine tip moth, Rhyacionia frustrana (Comstock), damages nearly all pine species in the South. Repeated attacks may deform or reduce growth of young trees (Beal 1967, Warren and Young 1972). Larval feeding on vegetative pine tips in late summer and fall can adversely affect flower production by destroying primordia (Yates 1960).

Foliar sprays of dimethoate, azinphosmethyl, and trichlorfon are registered for control of this species on ornamental and shade tree pines. However, to achieve maximum control with these insecticides, sprays have to be timed to coincide with the migration of early instars from needles to shoots for each generation (Yates 1967). In contrast, single applications of granular systemic have protected young pines from tip moth damage through multiple generations (Boyd et al. 1968). The only granular systemic insecticide presently registered for Nantucket pine tip moth control on ornamental pines is disulfoton (15% G).

Carbofuran (10 G), another granular systemic insecticide, has proved promising for controlling tip moths that attack one-year-old loblolly, Pinus taeda, slash, P. elliottii Engelm. var. elliottii, and sand pine, P. clausa (Chapm.), Vasey (Merkel and Hertel 1976), 5- to 6-year old loblolly pines (Boyd et al. 1968), and Japanese black pine, P. thunbergii Parl. (Kerr and Owebs 1973); however, at the present time it is not registered for these purposes.

During 1974, 1975, and 1976, field tests were conducted to determine the effectiveness of carbofuran for controlling Nantucket pine tip moth that attack shortleaf pine, P. echinata Mill., tips and conelets at the Stuart Seed Orchard (Kisatchie National Forest, U.S. Forest Service) near Pollock, La. This information repeats and extends the report developed in 1976 (Overgaard et al. 1976). The effects of carbofuran on pines, soil organisms, and birds are discussed in the same report.

METHODS

1974 Test. The shortleaf pines (Texas seed source) treated in the orchard were 4 - 7 years old, 1.2 - 6 m tall, and 5 - 30 cm d.b.h. The area was relatively flat with Bowie, Beauregard, and Muskogee loam soil types with the soil pH from 4.5 - 6. There were 4.3 m between each tree in a row and 8.3 m between rows.

Each treatment was applied to a randomly selected row of five trees in each of eight blocks. Figs. 1 and 2 list the rates and numbers of carbofuran applications. Untreated single rows of trees on each

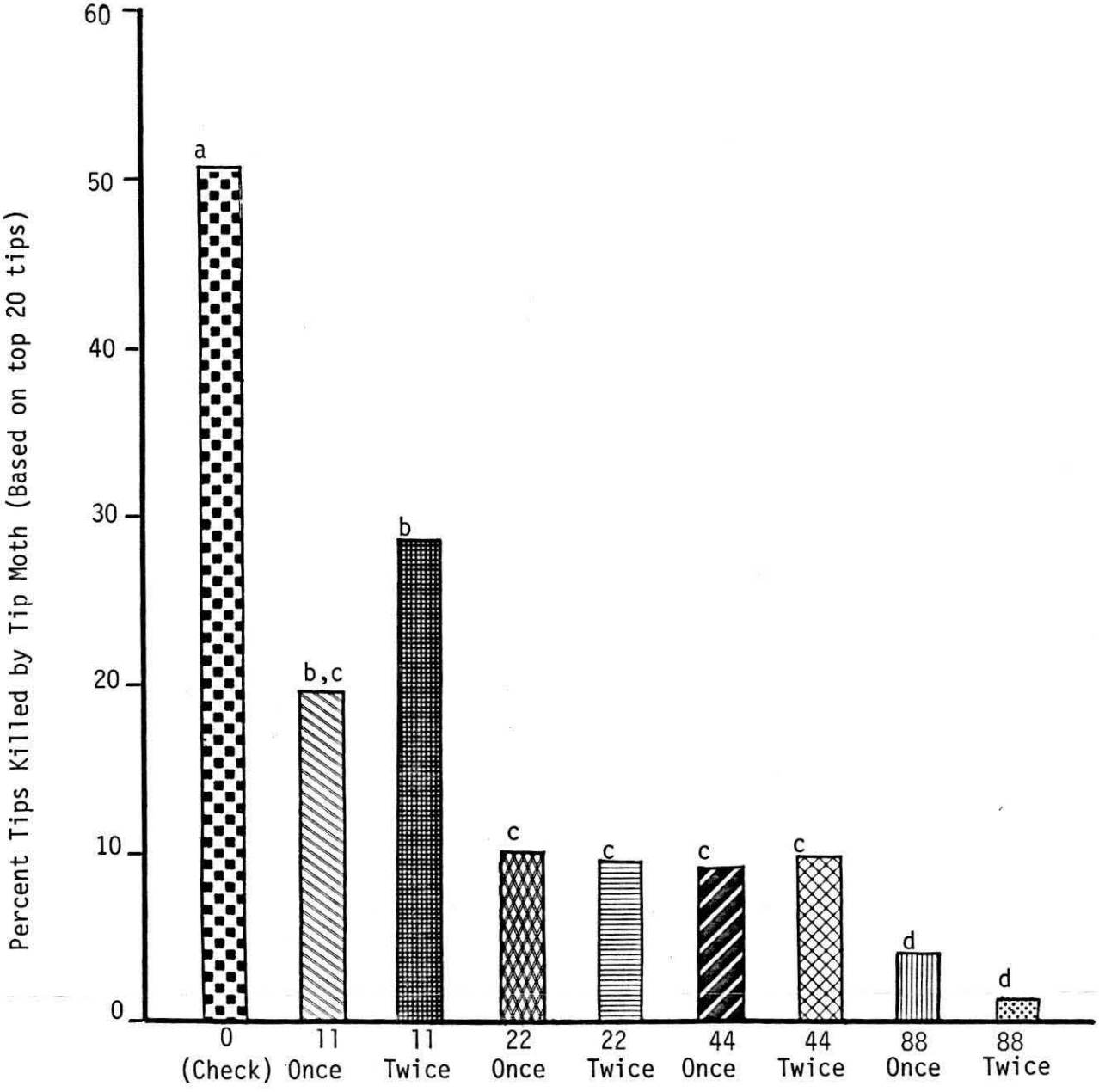

Fig. 1. Effects of carbofuran treatments on percentage of shortleaf pine shoots killed by Nantucket pine tip moth, October, 1974. Once: applied Feb. 1974; twice: applied Feb. 1974 and June 1974. Treatments not showing the same letter are significantly different at the 5 percent level of probability of Duncan's new multiple range test.

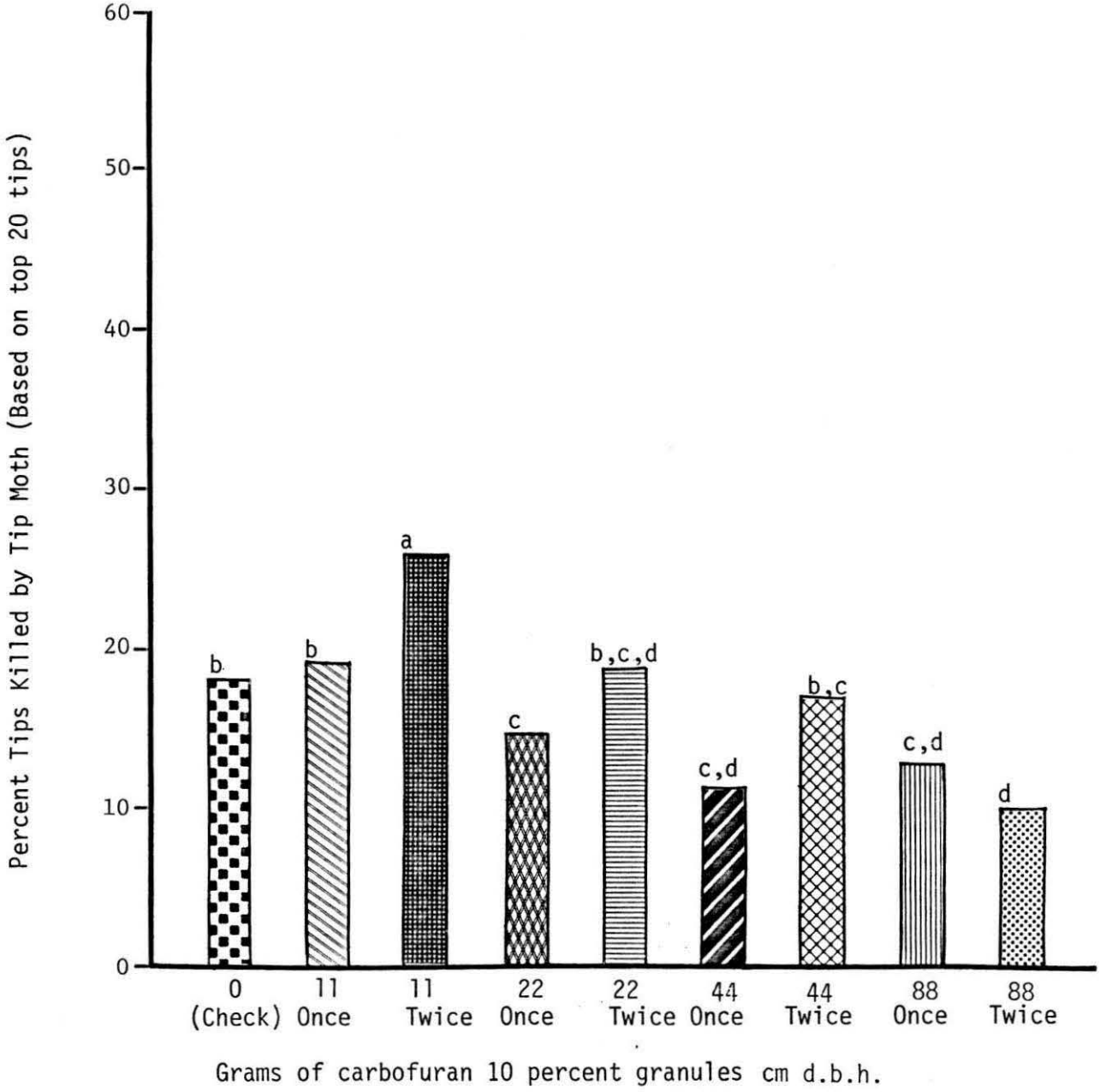

Fig. 2. Effects of carbofuran treatments on percentage of shortleaf pine shoots killed by the Nantucket pine tip moth, June 1975. Once: applied Feb. 1974; twice: applied Feb. 1974 and June 1974. Treatments not showing the same letter are significantly different at the 5 percent level of probability of Duncan's new multiple range test.

end of each block were used as buffer strips between blocks. The 8.6 m space between treatment rows was considered sufficient buffer laterally. A randomized block design was used.

During October 1974 and June 1975, 7,200 tips (top 20/tree) were checked for tip moth damage or feeding on 360 trees (5 trees x 9 treatments x 8 blocks).

For the February applications, the duff was removed within a 46 cm radius of the tree stem. Carbofuran was applied uniformly to this area and incorporated into the soil with a rake. Bird mortality, caused by feeding on exposed carbofuran granules on the soil surface, occurred from February treatments because raking was not effective in covering all the granules; therefore, June applications were applied to the 46 cm strip as before, but were lightly disked to a depth of 7.6 cm.

1975 Test. This carbofuran test was part of a southwide test to obtain registration for control of coneworms and seedbugs that attack cones and seed. In this case, the evaluation was extended to evaluate mortality of vegetative tips and conelets caused by tip moths through September 1975. The shortleaf pines treated were 8 to 10 years old, 8.5 m tall, and 15 cm. diameter. The topography, soils, and spacing were the same as in the 1974 test.

Six of the 50 clones of shortleaf pine in the orchard were selected for the evaluation. Treatments consisting of 44 g/cm d.b.h., 88 g/cm d.b.h., 132 g/cm d.b.h., and an untreated check were applied to one ramet of each clone for a total of 30 trees treated. Buffer and treatment trees were at least 8.6 m apart. The nearest operational spraying (dimethoate) was at least 36.6 m from the test area. A randomized block design was used in which clones were designated as to blocks.

Carbofuran was spread evenly over the soil surface by hand from the crown drip line to the trunk on all sides of treatment trees on Feb. 4, 1975. All insecticide treatments and one set of check trees were lightly disked within the drip zone to a depth of ca. 7.6 cm.

Six hundred tips (the top 20 of each tree) were checked for tip moth damage or feeding on 30 trees (1 tree x 5 treatments x 6 blocks [= clones]).

To assess conelet mortality, 10 percent of the conelets on each sample ramet were tagged in February 1975 and followed at monthly intervals until October 1975.

1976 Test. Two ramets of each of four clones in the same area of the Texas shortleaf geographical source that the 1975 test was conducted were given the following treatments: 1) 134 g carbofuran (12 oz/in d.b.h. [10% granular])/cm d.b.h. applied in October 1975, 2) 134 grams of carbofuran (10% granular)/cm d.b.h. applied February 1976, and 3) an untreated check. Carbofuran granules were applied by sprinkling premeasured quantities evenly from the trunk of the tree to the drip line and watering them in by hydraulic sprayer.

Tip moth damage to tips was assessed as in the 1975 test on June 18, 1976 and September 22, 1976.

The conelet mortality was assessed as in 1975 except that 20 percent of the conelets were tagged in February 1976 and followed monthly until October 1976.

1974, 1975, and 1976 Test. Rainfall data were taken from 1974, 1975, and 1976 records of the Catahoula Ranger District Weather Station located ca. 400 m from the orchard.

Analysis of variance and Duncan's multiple range test were conducted for data sets for each of these tests by using percent dead tips as the assigned variable measured. Additionally, percent dead conelets was analyzed as the assigned variable for the 1975 and 1976 tests.

The criterion of < 11 percent of the top 20 tips damaged is used as a basis for determining successful Nantucket pine tip moth control since healthy, rapidly-growing trees which produce an abundance of cone-producing tips are imperative in pine seed orchards.

RESULTS

1974 Test. Mean percentages of tip moth-killed tips in all carbofuran treatments were significantly lower than the check ($P > 0.05$) (Fig. 1) when trees were examined in October 1974; however, only the three highest dosages, i.e., 22, 44, and 88 g/cm d.b.h., resulted in successful tip protection (< 11 percent tip kill) for the entire season. Mean percentage tip kill at two carbofuran applications did not differ significantly from one application of each dosage rate. The 22 g application (applied once) would be the most economical treatment that would give acceptable control.

Examinations of these trees in June 1975 showed a significant difference among treatments (Fig. 2); however, control was not considered adequate for any of the treatments except for the 88 g treatment (applied twice). Trees treated twice with 11 g/cm d.b.h. sustained significantly more tip moth damage than all other treatments, including the untreated checks.

Cumulative rainfall was light to moderate (72 cm, February - September) during the period of the test. This was 19.5 less than the 10-year average (1966 - 1975) for this 8-month period. One day after completion of the February treatments ca. 1.2 cm of rain was recorded. Rainfall, however, was very light for ca. 30 days after the June treatments (< 2.5 cm for the entire period).

1975 Test. During the 1975 test, the 132 g/cm carbofuran treatment resulted in significantly fewer tips killed by tip moth than all other treatments (Table 1). The 44 g/cm and 88 g/cm treatments means did not differ significantly from each other or the untreated checks.

Conelet damage that could be attributed to tip moth attack accounted for only 0.6 percent of the conelets killed on control (disked) trees, 3.1 percent on control (not disked) trees, and 2.1 percent on the 34 g/cm d.b.h. Furadan® treatment.

Rainfall was 126 cm (February - September 1975), or 34.55 cm above the 10-year (1966 - 1975) average for this 8-month period. The heaviest precipitation, 36 cm, was in May.

1976 Test. Significantly greater (1% level) tip moth damage to tips was found on the check (10 percent) than on each the October (0 percent) and February (0 percent) treatment for the June 1976 examinations; however, there was no significant difference among treatments (October = 28 percent; February = 29 percent; untreated = 38 percent) for the October examinations (Table 2).

Some conelet protection from tip moths by carbofuran was shown by the fact that both the October (0 percent) and February (1.96 percent) treatment losses were significantly less (5% level) than the check treatment (8.55 percent).

Rainfall was 112 cm (Feb. - Sep. 1976), or 21 cm above the 10-year (1966 - 1975) average for this 8-month period.

DISCUSSION

Single applications of carbofuran made in February 1974 at rates as low as 22 g/cm of tree diameter gave season-long control of the

Table 1. Percent[a/] of tips killed by Nantucket pine tip moth on 10-year-old shortleaf pines treated with carbofuran (Feb. 4, 1975) at the Stuart Seed Orchard, Pollock, LA. (Observed Sept. 16, 1975).

Clone No.	Treatment				
	Untreated		Carbofuran (10% G)		
	not disked	disked[b/]	44 g/cm DBH	88 g/cm DBH	132 g/cm DBH
	- - - - - - - - - - - - - - - - percent - - - - - - - - - - - - - - - -				
2	85	95	90	0	0
4	60	60	85	5	30
7	85	65	35	90	5
8	80	70	20	75	20
10	75	65	55	70	0
11	35	15	45	60	0
Mean[c/]	70 a	61 a	68 a	50 a	9 b

a/ Observations based on 20 topmost tips of single ramets of each clone.

b/ Trees disked within the drip zone to a depth of ca. 7.6 cm.

c/ Any two means not followed by the same letter are significantly different at the 5% probability level by Duncan's multiple range test.

Table 2. Percent killed tips following carbofuran treatment in October 1975 and February 1976.

Month of Examination (1976)	October[1/]	February[1/]	Check
June	0	0	10
Sept.	28	29	38

[1/] 12 ounces of carbofuran/inch of tree DBH applied by hand from the trunk to the dripline of the tree and watered in.

Nantucket pine tip moth on shortleaf pines that averaged 4.3 m tall and 10 cm d.b.h., whereas six times 22 g, or 132 g/cm applied in February 1975, was required for effective tip moth control on shortleaf pines that averaged 8.5 m tall and 15 cm d.b.h. The 1975 tests showed effective control only at the higher dosage rates possibly because the insecticide was not translocated as readily to tops of the taller trees and/or because the insecticide was spread more dilutely thoughout the larger crowns (at least four times the volume). Further evaluation of the interrelationships between dosage rates of carbofuran needed to obtain control and tree size should be conducted. Other reasons may have been cutting of surface roots by disking during the 1975 test, thus inhibiting root absorption of the insecticide and leaching of carbofuran from the soil by heavy rainfall during 1975.

Protection to conelets from tip moth attack was demonstrated only in the 1976 test. Reasons for protection to conelets not being shown in 1975 may have been that the heavy rains during May 1975 knocked off tip moth-killed conelets before the monthly examination was made and tip moth populations were light in 1975. In future tests to assess tip moth conelet damage, more frequent inspections will be needed to assure that all tip moth-caused damage is detected before conelet drop. The October 1975 treatment was equal statistically to the February 1976 treatment for protecting tips and conelets from tip moth attack. The October treatment averaged fewer damaged conelets than the February treatment. This may be due to the fact that the insecticide was present during the period conelets were developing; thus, it was more readily translocated to the conelet issues.

The reasons that tip protection did not last the full season at the 132 g/cm d.b.h. rate during 1976 is not known. Only slightly less rainfall occurred in 1976 than 1975; so difference in rainfall between years could be eliminated as a reason. More tests need to be conducted over a variety of climates and soil types to adequately assess carbofuran for tip moth control in seed orchards. Eight clones with two ramets per clone should be used in future similar tests to obtain a more sensitive test of significance.

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